Angra TRIGGER system: possible solution for LIME?

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24 Feb 2021

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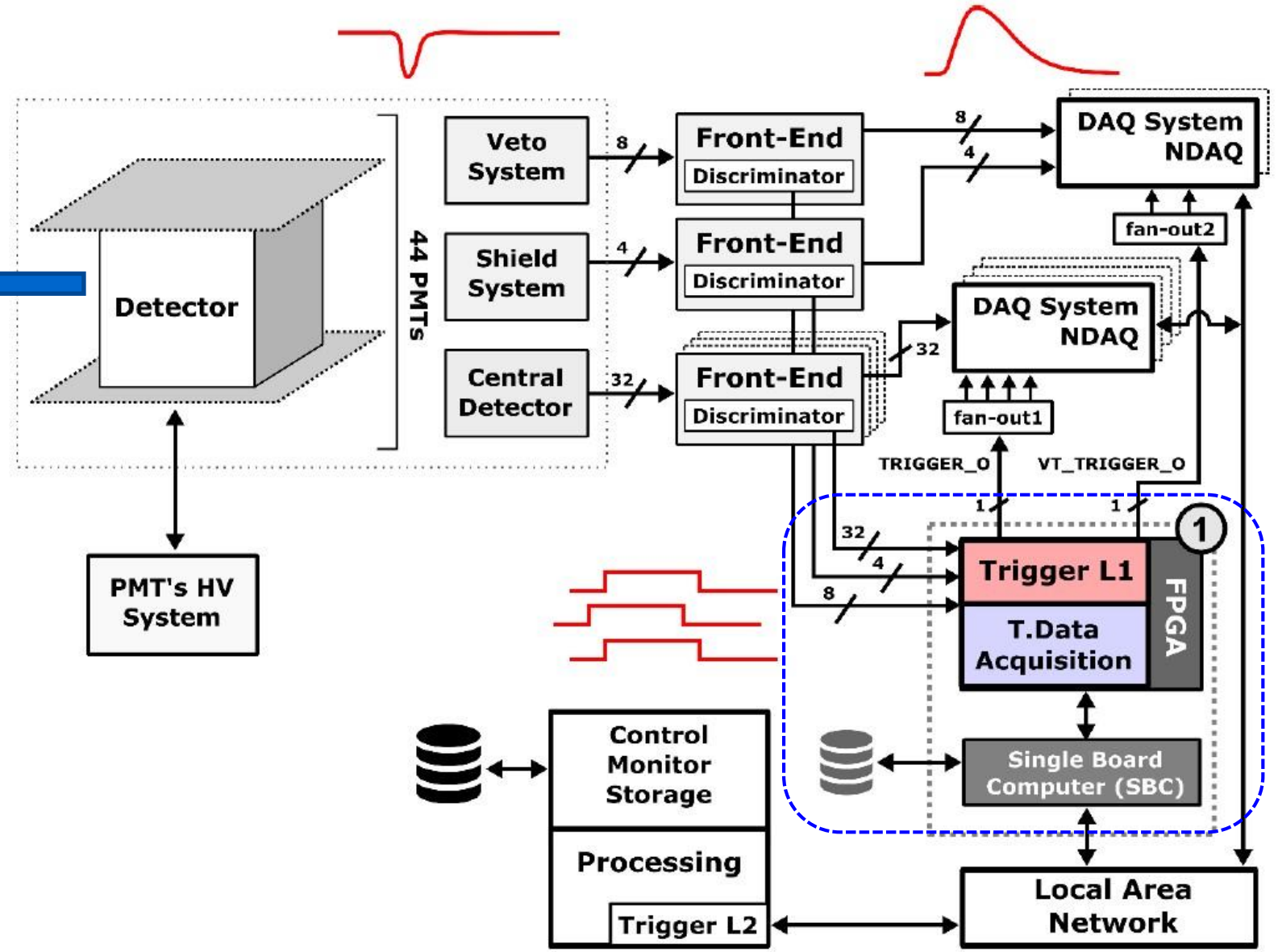
Background

- The TRIGGER system of the Neutrinos Angra experiment is based on commercial electronics and custom firmware/software.
- The original code was developed by a master student some years ago (João Marcelo / UFBA).
- The FPGA logic design is written in Verilog language. The RaspberryPI code is based on Python.
- For LIME, maybe the most interesting feature is not the trigger logic in the FPGA (which is very experiment-driven), but the remote configuration scheme that works using SPI communication protocol between the FPGA and the RaspPI. It is possible to configure internal registers in the FPGA and change the trigger conditions remotely through Ethernet.
- It is also possible to remotely reconfigure the FPGA through a USB cable locally connected to a PC.
- The FPGA kit is an old model (Altera DE2 - Cyclone II FPGA), but the design could be programmed in a similar and newer FPGA kit (see slide ahead), with pin assignment modifications.

Context: Neutrinos Angra experiment

Neutrino detector based on Gd-doped water



Could be used in **LIME**?

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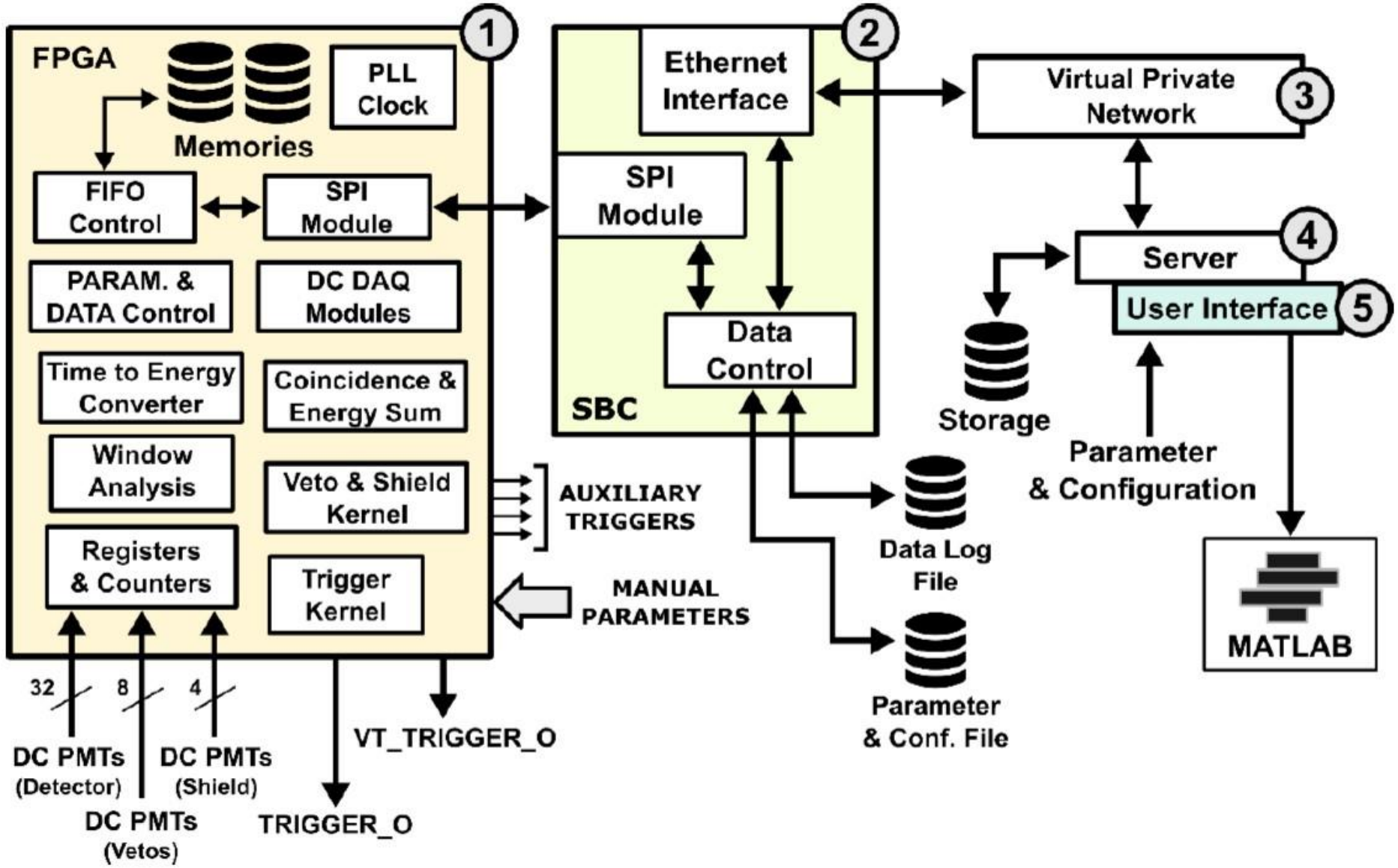
Trigger System overview



SBC = Raspberry PI

In the folder **/home/pi** there is the following files structure:

- **conf**
  - RUN.CONF
  - TRIGGER.CONF
  - VERSION.CONF
- **ctrl_trigger_sockt.py**
- download.sh
- **init_boot.sh**
- **lib**
  - test_spi_bit.py
- **log**
  - DATA_LOG.LOG
  - IDD_RUN_LOG.LOG
  - STATUS_LOG.LOG
- spilibx.py
- spilibx.pyc
- **trigger_process.py**
- **util**
  - ftp_con_trigger.sh

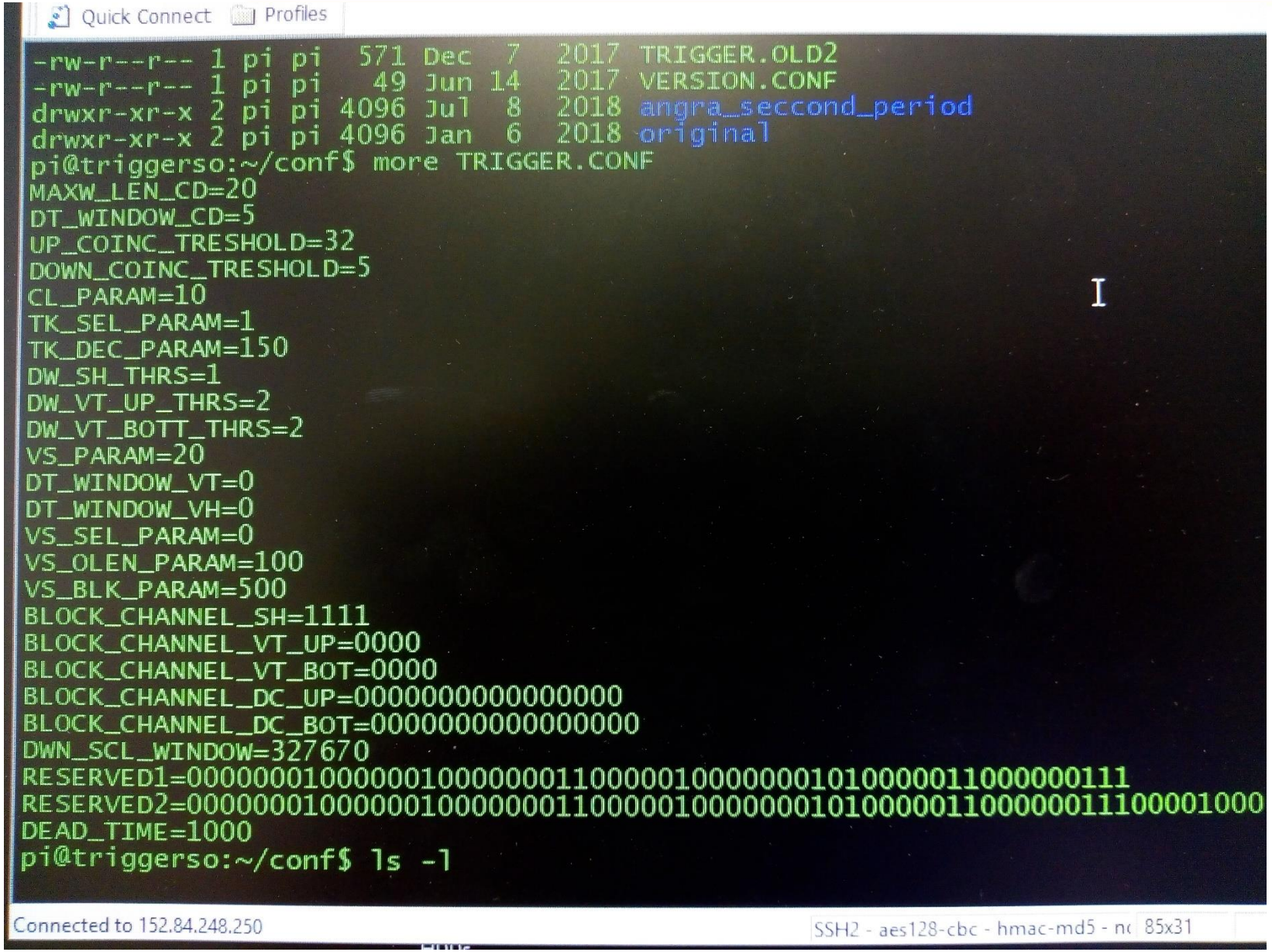
This text file should be edited in order to implement different Trigger conditions in the FPGA logic.

In the folder **/etc/init.d** there is an initialization service that calls the file *init_boot.sh*, which then calls the processes *ctrl_trigger_sockt.py* and *trigger_process.py*.

In order to access the Raspberry PI it is necessary to know its IP address in the private network and to use the following credentials:

- Login: pi
- Password: lsd

TRIGGER.CONF file



The values in this file are serially written into the FPGA registers through the SPI interface between the RaspPI and the FPGA.

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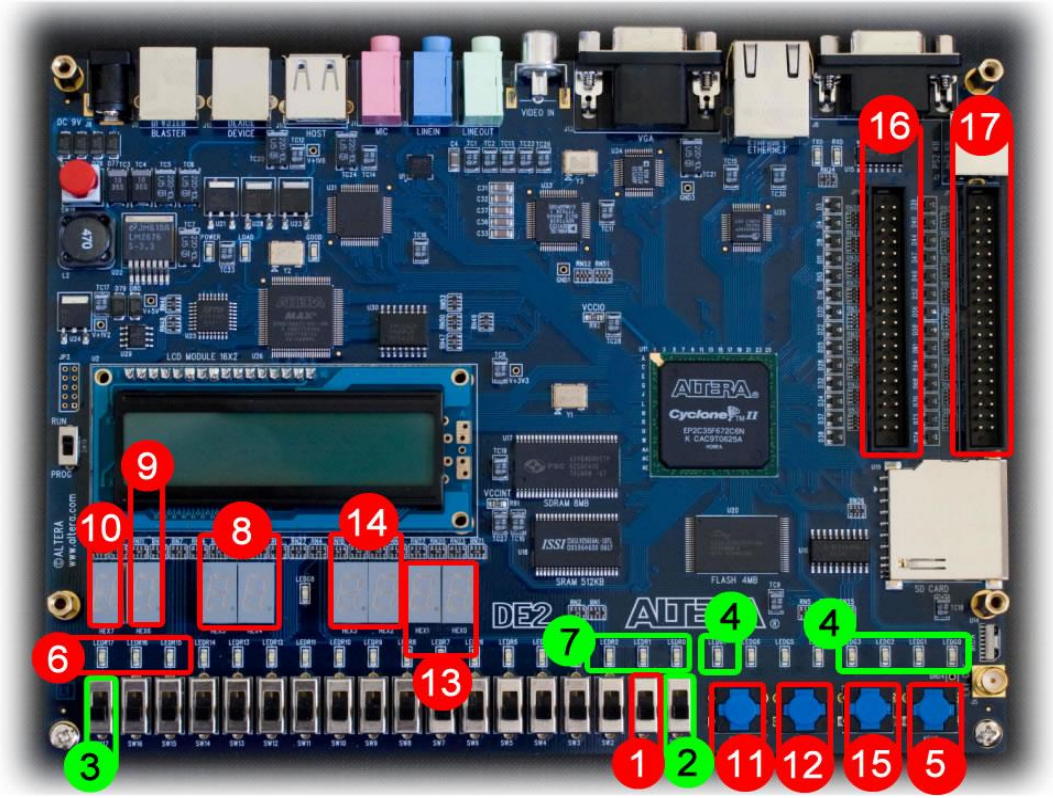
Current hardware



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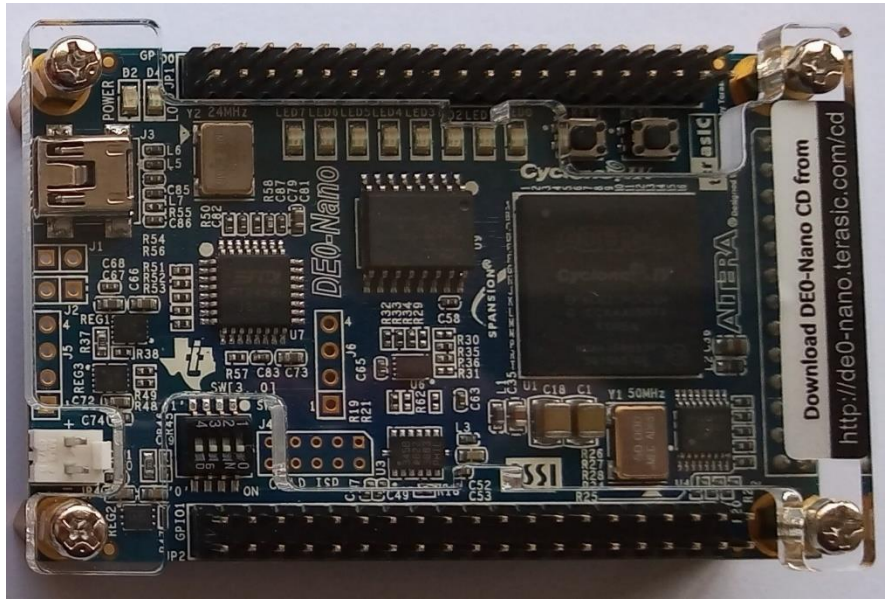
Altera DE2 FPGA Kit

Raspberry PI B+

New hardware for LIME

These boards are already available at CBPF for development and tests.



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Terasic DE0 Nano FPGA Kit (US$86)
Cyclone IV EP4CE22F17C6N

Raspberry PI 3 Model B (US$43)

What need to be done for LIME?

- Pin assignment modifications for the new FPGA kit. **ONGOING**...
- Check software compatibility with the available RaspberryPI.
- Make all the connections between the FGPA kit and the RaspPI.
- Build a mechanical solution to assemble both boards on the same framework (VME?, NIM?)
- Perform functional tests with the modified system.